

REMARKS

The Examiner is thanked for the due consideration given the application.

Claims 1-7 and 9-18 are pending in the application. Claim 17 has been withdrawn from consideration. Support for the amendments to claim 1 can be found in paragraph 0033 of the specification.

Rejection Over HIRATA et al.

Claims 1-7, 9-16 and 18 have been rejected under 35 USC §103(a) as being unpatentable over HIRATA et al. This rejection is respectfully traversed.

The present invention pertains to a method allowing the removal of metals in ionic form in solution in water or aqueous effluents in which a metal completely or partially coated with hydrogen is utilized. This method aims at the elimination of these metal ions in the aqueous effluents from industry and for the treatment of water for human consumption.

Instant claim 1 of the present invention sets forth:

1. A method for reducing a content of contaminating metals in ionic form present in aqueous effluents, comprising:

(a) providing an aqueous effluent comprising at least a metal M_i in ionic form;

(b) treating the aqueous effluent with at least a metal M_h completely or partially coated with hydrogen during the treatment of the metal ion(s) M_i , **wherein the metal ions M_i are chemisorbed on the metal M_h** ; and

(c) recovering an aqueous effluent from which the metal M_i has been eliminated or its content reduced.

The Official Action assert that HIRATA et al. disclose a method for reducing the content of contaminating metals in ionic form present in aqueous effluents, the method including the steps of providing an aqueous effluent including at least a metal in ionic form, placing the aqueous effluent in contact with at least a metal that is "obviously" completely or partially coated with hydrogen before and during the placing in contact with the metal ions; and recovering the aqueous effluent.

However, a detailed review of the disclosure of HIRATA et al. will review fundamental differences between this reference and the present invention.

Column 1, fourth paragraph of HIRATA et al. explains the following:

However, when the present inventors have attempted to recover a noble metal by passing a plating waste water containing noble metal complex ions such as gold cyano complex ions or palladium complex ions through the column packed

with such a metal ion-treating agent, it has been impossible to sufficiently reduce and capture the noble metal complex ions, even though the redox reaction reagent in the metal ion-treating agent is present in a reducing form (an anthrahydroquinone form) . . .

To summarize, HIRATA et al. disclosed an ancient method of absorbing a reducing complex of the supported anthrahydroquinone type ("ion-treating agent"), and to have it reacting with a noble metal in solution. The noble metal may be easily reduced, so that it goes to the zero state, precipitates, and is recovered from the solution. However, the method appeared to be insufficiently efficient.

Then the HIRATA et al. reference comes to its inventive concept in the last paragraph of column 1:

To accomplish the object, the present inventors have conducted an extensive research for a method whereby the reduction reaction of noble metal complex ions will smoothly proceed on the metal ion-treating agent and as a result, have reached a concept that transfer of electrons on the metal ion-treating agent is hindered by some factors, whereby the reduction rate of the noble metal complex ions tends to be low. Accordingly, they have studied a method for improving the reduction rate, and as a result have reached an idea that the transfer rate of electrons can be improved by

having a metal preliminarily supported on the metal ion-treating agent. Accordingly, an aqueous solution containing noble metal complex ions has been treated by means of a metal ion-treating agent having a metal such as copper supported on a carbonaceous carrier, whereby it has been found that the recovery rate of the noble metal can remarkably be improved. The present invention has been accomplished on the basis of this discovery.

Therefore, to rapidly eliminate the noble metal ions, HIRATA et al, add to the "ion-treating agent", a metal which will help the electron transfer.

Column 3, second full paragraph of HIRATA et al. states:

However, when the present inventors have attempted to recover a noble metal by passing a plating waste water containing noble metal complex ions such as gold cyano complex ions or palladium complex ions through the column packed with such a metal ion-treating agent, it has been impossible to sufficiently reduce and capture the noble metal complex ions, even though the redox reaction reagent in the metal ion-treating agent is present in a reducing form (an anthrahydroquinone form) . . .

HIRATA et al. suggest having a previously deposited metal such as copper or silver for the treatment

of gold (under the form of a cyanide) and nickel or cobalt for palladium (also under the form of a cyanide). Column 4, fifth paragraph of HIRATA et al. states:

In the present invention, when cyano complex ions such as gold cyano complex ions, are to be treated by the metal ion-treating agent having the above metal supported thereon, it is preferred to carry out the treatment in the presence of an aldehyde which is capable of reacting with cyan compound ions freed by the reduction reaction by means of the metal ion-treating agent.

It appears that the anthrahydroquinone is not sufficient to completely reduce the formed complex gold-cyanide or palladium-cyanide, so that HIRATA et al. provide for the addition of an aldehyde in solution, with a concentration that is at least equimolar (preferably 1.2 to 50 equivalents) to the cyanide complex to be eliminated.

Column 6, third paragraph of HIRATA et al. state:

The mechanism in which the noble metal complex ions are captured in the form of metal on the metal ion-treating agent having the metal supported thereon, has not been clearly understood. However, as assumed from the phenomenal aspect, it is considered that when the noble metal complex ions are in contact with the treating agent, the complex ions are reduced by

the anthraquinone compound by means of the metal supported on the treating agent, whereby the noble metal will be laminated and will grow to form a noble metal coating film on the treating agent.

The anthrahydroquinone (or anthraquinone) is the reducing agent and the deposited metal (Ni, Cu, Co, Ag for instance) has the role of a catalyst. And it may be seen from the example, that the amount of this deposited metal is catalytic with an amount 100 times less than the noble metal to be eliminated.

It is thus evident that the process of HIRATA et al. treats the aqueous effluent containing noble metal ions **by reduction of the noble metal ions into the form of noble metal**. This is disclosed in column 6, lines 9-18: "*the complex ions are reduced to metal on the treating agent and thereby selectively capture (...)* The treating agent having the noble metal captured thereon was analyzed by powder X-ray refraction method, whereby it was confirmed that the noble metal complex ions were captured **in the form of metal**." (emphasis added).

In Example 1, HIRATA et al. prepared the ion-treating agent with nickel.

EXAMPLE 1

(a) Preparation of a Metal Ion-treating Agent having 1,4-dihydro-9,10-dihydroxyanthracene (hereinafter referred to as DDA) supported on active carbon . . .

(c) Supporting Nickel on the Metal Ion-treating agent

Nickel chloride was dissolved in deionized water, 25% aqueous ammonia was added thereto to prepare an aqueous solution containing 1000 ppm as nickel of tetraammine nickel. The metal ion-treating agent in the step (a) was sampled in a wet volume of 20 ml, and 100 ml of deionized water was added thereto. Then, 1 g of sodium hydrosulfite was added thereto. To this mixture, the above nickel ion aqueous solution was added in an amount of 40 ml, and 0.5 g of sodium hydrosulfite was further added. The mixture was thoroughly shaken, whereby it was observed that nickel metal precipitated by reduction on the surface of the metal ion-treating agent and was laminated in a white color.

At column 7, line 14 of HIRATA et al. the amount of nickel is said to be 2 g of nickel supported per 1e in the wet volume of the metal ion-treating agent - thus 19.4 mmol/L. In step (d) at column 7 they used 10 ml of this agent, which represents 0.345 mmol of nickel. Then an 800 ml solution containing 1243 ppm of Pd was treated until the amount of Pd in the solution was not more than 0.1 ppm

(Table 1). **9.06 mmol** of Pd was recovered, i.e., **20 times more than the amount of Ni that has been predeposited.**

In Example 2, HIRATA et al. used among others the same ion-treating agent with deposited Ni as in example 1. They treated as follows: *"A cyan type gold plating waste water containing dicyano aurate(I) complex ions as the main component (containing 3300 ppm as gold, and the pH was 6.8) was diluted ten times, and 4 g of paraformaldehyde per liter was added . . ."*

4 L of the solution was treated before the residual amount is not more than 0.1 ppm, i.e. they extracted 6.7 mmol of Au, i.e., **20 times more than the amount of Ni that has been predeposited.**

In Example 3, HIRATA et al. deposited Cu, Ni or Pd on the support and then the hydroquinone.

The supported amount of DDA per 1 L of each metal-supported active carbon was shown in Table 3, which is reproduced below.

TABLE 3

Supported metal	Supported amount of DDA (mol)
0.2% Ni	0.79
0.2% Cu	0.79
0.2% Pd	0.76

Column 10, lines 24-31 of HIRATA et al. states:

As shown in Table 4, although there were some differences depending upon the supported metals, for example, with a metal ion-treating agent having 0.2% nickel supported thereon, the recovery rate of gold was at least 90% until sl of the-cyan type gold plating waste water was treated, and the recovered amount of gold at that time was at least 160 g per le of the metal ion-treating agent.

TABLE 4

Example No.	Content calculated as gold	Supported metal	Amount of treated water (Total amount) (λ)	Concentration of gold ions in the eluate (ppm)
Example 3	330 ppm	Copper	0.5	0.2
			1.0	0.1
			4.0	0.1
			5.0	0.1
			6.0	30.2
	330 ppm	Nickel	0.5	0.1
			1.0	0.2
			4.0	0.4
			5.0	8.0
			6.0	40.8
	330 ppm	Palladium	0.5	0.1
			1.0	0.1
			3.0	0.1
			4.0	50.2
			5.0	280.5

This means that with 2 g (34.5 mmol) of Ni in the ion-treating agent, the authors eliminated 160 g of gold (812 mmol). Therefore, they eliminated **20 times more gold than the amount of active Ni.**

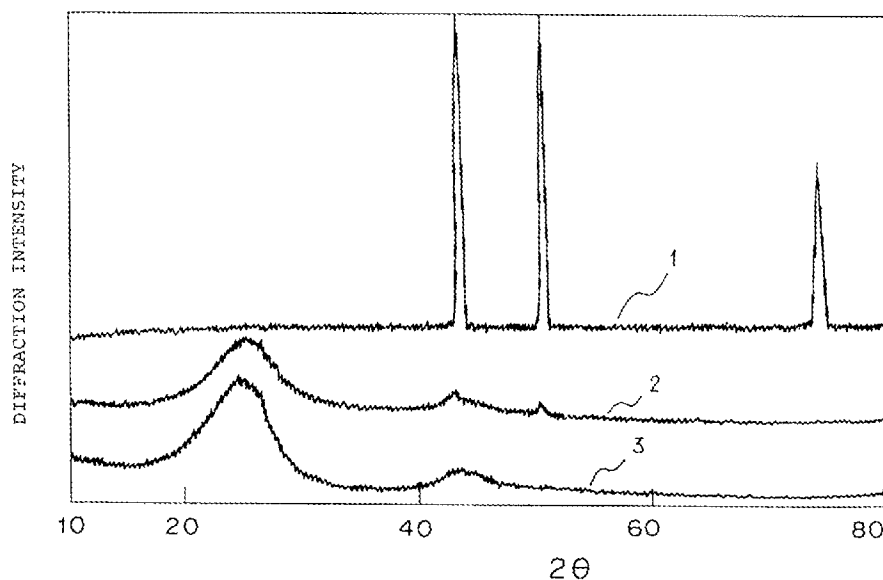
Due to the higher amount (20 times more) of noble metal versus the previously deposited metal (Cu, Ni, etc.), it is evident that the noble metal is under the form of a noble metal coating on the deposited metal. Besides, this

is clearly mentioned in HIRATA et al. at column 6 lines 22-28: ***"when the noble metal complex ions are in contact with the treating agent, the complex ions are reduced by the anthraquinone compound by means of the metal supported on the treating agent, whereby the noble metal will be laminated and will grow to form a noble metal coating film on the treating agent."***

Thus it is to be understood that the reducing agent is the anthraquinone, the role of metal (Ni, Cu, Co, Ag) is as a catalyst. This is supported by the examples in which the maximal quantity of metal (Ni, Cu, Co, Ag) is more than hundred times weaker than the quantity of noble metal eliminated.

Finally, a definitive proof of the deposit of a noble metal into the form of a solid film (case of the HIRATA et al. patent) but not into the form of an atom strongly adsorbed (chemisorbed as in the present invention) on the predeposited-nickel surface is given by Figure 1 of the HIRATA et al. patent, which is reproduced below.

FIGURE 1



This Figure represents a X-ray diffraction spectrum. Spectrum 1 is the spectrum of a copper sheet and spectrum 2 is the spectrum of the solid after the elimination of copper from a copper tetraamine solution (Example 2). We can observe peaks corresponding to solid copper and not to copper chemisorbed on nickel surface of the particles as claimed in the present invention.

In HIRATA et al. the metal complexes ions are reduced in the form of metal.

In comparison, in the present invention, the metal ions M_i are individually chemisorbed on the metal M_h , into the form of atom (see paragraph 0035 of the specification).

The term "chemisorption" is explained in paragraph 0031 of the specification: the presence of a strong chemical bond between the metal ions M_i and the metal M_h .

The method of HIRATA et al. is based on a completely different concept and chemistry. As it has been explained above, and as it is evident from the explanation given by HIRATA et al. at column 6, lines 19-26 ("*when the noble metal complex ions are in contact with the treating agent, the complex ions are reduced by the anthraquinone compound by means of the metal supported on the treating agent, whereby **the noble metal will be laminated and will grow to form a noble metal coating film on the treating agent***"), a coating of deposited noble metal is obtained. There is no individual metal to metal bonds such as M_i chemisorbed on the metal M_h in the present invention.

Indeed, the use is not the same, and the scale of the processes are different.

HIRATA et al. thus pertain to the field of the recovery of noble metals from waste waters produced in the noble metal industry, with waste waters containing high amounts of the noble metal.

In contrast, the present inventions aims at treating waste water, effluents, natural waters that may

contain various amounts of metals to be eliminated, including small or trace amounts of very toxic metals that have to be eliminated to allow water consumption. The method of the invention is conceived and scaled to this area and allows the elimination of high or low (including trace) amounts of metal ions. This is rendered possible due to the very specific way the inventive method proceeds, i.e., by chemisorption.

There is no reason for one skilled in the art to modify its process which is suited to its specific industry or technical area, in the direction of the invention. Beside, HIRATA et al. is based on the reduction of the ions to a zero metal for its deposition to form a coating, and nothing can lead the person skilled in the art to consider the chemisorption process of the invention.

Thus the present invention is new and inventive in view of HIRATA et al., and a *prima facie* case of unpatentability has thus not been made.

The above observations can be re-presented in the form of a Declaration, if desired.

This rejection is believed to be overcome, and withdrawal thereof is respectfully requested.

Conclusion

It is believed that the rejection has been overcome, obviated or rendered moot, and no issues remain. The Examiner is accordingly respectfully requested to place the application in condition for allowance and to issue a Notice of Allowability.

The Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 25-0120 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17.

Respectfully submitted,

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